

WHAT IS CLAIMED IS:

1 1. A refractive projection objective for use in
2 microlithography, comprising a lens arrangement with a
3 system diaphragm, wherein the lens arrangement consists of
4 lenses made exclusively of one and the same material,
5 wherein the objective has an optical axis, an object field,
6 an image field, and an image-side numerical aperture larger
7 than 0.7, wherein a light bundle propagating through the
8 objective is defined by said image field and said image-side
9 numerical aperture and has within the objective a variable
10 light-bundle diameter smaller than or equal to a maximum
11 light-bundle diameter, and wherein in a length interval
12 measured on the optical axis from the system diaphragm
13 towards the object field and at least equaling said maximum
14 light-bundle diameter, said variable light-bundle diameter
15 exceeds 85% of said maximum light-bundle diameter.

1 2. The objective of claim 1, comprising a first
2 waist arranged between two bulges and further comprising at
3 least four doublets following said first waist relative to a
4 direction of light propagation, each doublet consisting of a
5 negative lens and a positive lens.

1 3. The objective of claim 2, comprising a second
2 waist formed of two consecutive negative lenses arranged
3 between two positive lenses, wherein each of said positive
4 lenses has a convex lens surface facing towards said
5 negative lenses.

1 4. The objective of claim 3, wherein the light-
2 bundle diameter in the second waist exceeds 85% of the
3 maximum light-bundle diameter.

1 5. The objective of claim 2, wherein in each of
2 said doublets the negative lens immediately follows the
3 positive lens relative to said direction of light
4 propagation.

1 6. The objective of claim 2, wherein each of said
2 doublets has a respective average lens diameter between the
3 positive lens and the negative lens of said doublet, and
4 wherein mutually facing lens surfaces of the positive lens
5 and the negative lens of each of said doublets are spaced
6 from each other at a distance shorter than 10% of said
7 respective average lens diameter.

1 7. The objective of claim 2, wherein in at least
2 three of said doublets said positive lens and said negative
3 lens have mutually facing lens surfaces spaced less than 10
4 mm from each other.

1 8. The objective of claim 1, wherein the first two
2 of the lenses relative to a direction of light propagation
3 have a negative refractive power and are curved towards said
4 object field.

1 9. The objective of claim 2, wherein the first
2 waist consists of three negative lenses.

1 10. The objective of claim 1, wherein the first
2 three of the lenses relative to a direction of light
3 propagation have a negative refractive power.

1 11. A microlithography projection system comprising
2 the objective of claim 1.

1 12. A method of manufacturing a component
2 comprising a microstructure on a substrate, with the steps

3 of:

4 - applying a light-sensitive coating to the substrate;

5 - exposing the light-sensitive coating to ultraviolet laser

6 light by means of a projection system and a mask of the

7 microstructure; and

8 - developing the light-sensitive coating, whereby the

9 microstructure is formed on the substrate;

10 wherein the projection system comprises the objective of

11 claim 1.

1 13. A refractive projection objective for use in

2 microlithography, comprising a lens arrangement with a

3 system diaphragm, wherein the lens arrangement consists of

4 lenses made exclusively of one and the same material,

5 wherein each of the lenses has a diameter less than or equal

6 to a maximum lens diameter, wherein the objective has an

7 optical axis, an object field, an image field, and an image-

8 side numerical aperture larger than 0.7, wherein a light

9 bundle propagating through the objective is defined by said

10 image field and said image-side numerical aperture and has

11 within the objective a variable light-bundle diameter, and

12 wherein in a length interval measured on the optical axis

13 from the system diaphragm towards the object field and at

14 least equaling said maximum lens diameter, said variable
15 light-bundle diameter exceeds 85% of said maximum lens
16 diameter.

1 14. The objective of claim 13, comprising a first
2 waist arranged between two bulges and further comprising at
3 least four doublets following said first waist relative to a
4 direction of light propagation, each doublet consisting of a
5 negative lens and a positive lens.

1 15. The objective of claim 14, comprising a second
2 waist formed of two consecutive negative lenses arranged
3 between two positive lenses, wherein each of said positive
4 lenses has a convex lens surface facing towards said
5 negative lenses.

1 16. The objective of claim 15, wherein the light-
2 bundle diameter in the second waist exceeds 85% of the
3 maximum light-bundle diameter.

1 17. The objective of claim 14, wherein in each of
2 said doublets the negative lens immediately follows the
3 positive lens relative to said direction of light

4 propagation.

1 18. The objective of claim 14, wherein each of said
2 doublets has a respective average lens diameter between the
3 positive lens and the negative lens of said doublet, and
4 wherein mutually facing lens surfaces of the positive lens
5 and the negative lens of each of said doublets are spaced
6 from each other at a distance shorter than 10% of said
7 respective average lens diameter.

1 19. The objective of claim 14, wherein in at least
2 three of said doublets said positive lens and said negative
3 lens have mutually facing lens surfaces spaced less than 10
4 mm from each other.

1 20. The objective of claim 13, wherein the first
2 two of the lenses relative to a direction of light
3 propagation have a negative refractive power and are curved
4 towards said object field.

1 21. The objective of claim 14, wherein the first
2 waist consists of three negative lenses.

1 22. The objective of claim 13, wherein the first
2 three of the lenses relative to a direction of light
3 propagation have a negative refractive power.

1 23. A microlithography projection system comprising
2 the objective of claim 13.

1 24. A method of manufacturing a component
2 comprising a microstructure on a substrate, with the steps
3 of:
4 - applying a light-sensitive coating to the substrate;
5 - exposing the light-sensitive coating to ultraviolet laser
6 light by means of a projection system and a mask of the
7 microstructure; and
8 - developing the light-sensitive coating, whereby the
9 microstructure is formed on the substrate;
10 wherein the projection system comprises the objective of
11 claim 13.

1 25. A refractive projection objective for use in
2 microlithography, comprising a lens arrangement that
3 consists of lenses made exclusively of one and the same
4 material, wherein said objective has a numerical aperture of

5 at least 0.8 and is configured for light of a wavelength
6 shorter than 300 nm within a defined bandwidth of $\Delta\lambda$, and
7 wherein the objective is characterized by a characteristic
8 index KCHL defined as

9
$$KCHL = \frac{CHL[nm]}{\Delta\lambda[nm] * \left(\frac{\Delta n}{n-1}\right) * y'_{max}[nm]}, \text{ wherein}$$

10 CHL represents a longitudinal chromatic aberration and y'_{max}
11 represents a maximum image field diameter of the objective,
12 and wherein the characteristic index KCHL is less than or
13 equal to 5.5.

1 26. The objective of claim 25, wherein the
2 characteristic index KCHL is less than or equal to 5.0.

1 27. The objective of claim 26, wherein the
2 characteristic index KCHL is less than or equal to 4.8.

1 28. A microlithography projection system comprising
2 the objective of claim 25.

1 29. A method of manufacturing a component
2 comprising a microstructure on a substrate, with the steps
3 of:

4 - applying a light-sensitive coating to the substrate;
5 - exposing the light-sensitive coating to ultraviolet laser
6 light by means of a projection system and a mask of the
7 microstructure; and
8 - developing the light-sensitive coating, whereby the
9 microstructure is formed on the substrate;
10 wherein the projection system comprises the objective of
11 claim 25.

1 30. A refractive projection objective for use in
2 microlithography, comprising a lens arrangement with a
3 system diaphragm, wherein the lens arrangement is subdivided
4 into three lens groups with a first lens group of positive
5 refractive power forming a first bulge, followed by a second
6 lens group of negative refractive power forming a waist,
7 followed by a third lens group having an elongated
8 configuration taking up 60% of a length measured from the
9 object field to the image field, and wherein the system
10 diaphragm is arranged in the third lens group.

1 31. A microlithography projection system comprising
2 the objective of claim 30.

1 32. A method of manufacturing a component
2 comprising a microstructure on a substrate, with the steps
3 of:
4 - applying a light-sensitive coating to the substrate;
5 - exposing the light-sensitive coating to ultraviolet laser
6 light by means of a projection system and a mask of the
7 microstructure; and
8 - developing the light-sensitive coating, whereby the
9 microstructure is formed on the substrate;
10 wherein the projection system comprises the objective of
11 claim 30.